REMARKS

A new claim has been presented to state that the metallic mold has a sidewall and the sheet product is placed into the metallic mold such that the sheet product is spaced apart from a sidewall of the metallic mold. Figure 1 illustrates this arrangement.

The rejection of claims 1-13 on the grounds of double patenting over the '503 patent in view of Kingery and also under 35 U.S.C. 103 over Hirao in view of Kingery, possibly further combined with Adachi and Kawai is respectfully traversed. The combination of references do not teach or suggest the present invention.

Conventionally, a ceramic laminate is produced by laminating ceramic green sheets, press bonding the sheets to one another and firing the resulting stack. In such a method, the pressing is such that the area of the respective grain sheets in the direction of perpendicular to the pressing axis are prevented from increasing and the crystal grains of the ceramic are not oriented. Alternative methods which produce oriented ceramics are known but those methods are generally expensive and unsuited for mass production. The present Applicants discovered that an oriented product could be produced by the process which is that set forth in the claims of the present application.

The double patenting rejection asserts that the '503 patent claims are insufficient in that they fail to call for a metal mold, a deficiency remedied by Kingery. It is respectfully submitted that the reliance on Kingery is misplaced for at least two reasons. First, the sentence to which reference has been made refers to compaction of a "powder" and not a sheet product. Secondly, the same paragraph teaches away from use of a metal mold in that it says use of a metal mold leads to pressure gradients and a resulting variation of density, which during sintering leads to a variation in shrinkage

and a loss of tolerances, and recommends use of a rubber mold. The claimed invention is not obvious.

The Hirao patent discloses a method in which a silicon nitride raw material powder and beta-silicon nitride single crystals in raw-like form are combined, formed into a slurry which is converted into sheets, stacked under pressure and then sintered. There is no teaching or suggestion that the orientation degree can be changed, as in the present invention. That change is a necessary consequence of the claimed method. While the Office Action makes reference to hot pressing to obtain a "prescribed thickness", and "Conservation of Mass", it is respectfully pointed out that such observations ignore the possibility that the heat can serve to drive off air in the sheets or trapped between sheets or drive off binder in the sheets, and pressing can orient particles and thereby reduce thickness. Hirao's actions may densify the sheets by reducing their thickness, but that does not mean that "the area of a plane perpendicular to the pressing axis of the product is increased compared to that before the pressing", as recited in claim 1 of this application. Nothing in Hirao suggests increasing the area of that plane. The assertion that increase is inherent because the extra material must move/flow somewhere is invalid because it incorrectly assumes that "somewhere" cannot be elsewhere, i.e., completely removed from the sheets/stack, especially in the face to Hirao's teaching that heat removes binder (col. 4, lines 59-60). The assertion also assumes without any basis that the sheet area is not already constrained by the sides of the mold. The secondary references are insufficient to obviate this deficiency. Further, the reliance on Kingery is not valid for the reasons set forth above.

In addition, claims 4, 5, 6 and 8 recite that the ceramic crystal grains having a shape-anisotropy are flat with an aspect ratio of about 4 to 10. While the Hirao patent does make reference to an aspect ratio being greater than 2 in column 4, that ratio relates to the seed crystals which are rod shaped as opposed to being flat. It is proper

to give a term its broadest reasonable interpretation, but rods, by definition, are cylindrical, not flat. Also, the Office Action observation that the rods are "lying flat" concerns how the rods are orientated and cannot make the rods themselves flat; these claims require the ceramic to be flat. The secondary references do not cure this deficiency. Indeed, neither Adachi or Kawai teach or suggest a ceramic material having a shape anisotropy.

The Adachi reference relates to a method of fabricating a ceramic multi-layer substrate in which a plurality of grain sheets are laminated, sandwiched between restricting green layers, pressed and fired. In an example, there was a thickness reduction. However, like the primary reference, Adachi does not relate to increasing the orientation degree, which is a consequence of the claimed method. Further, this reference does not disclose that the area in the plane perpendicular to the pressing axis of the green sheet is increased compared to that before pressing.

Kawai relates to the manufacture of a gas discharge type display panel in which a glass paste and glass green sheets are manipulated. In order to avoid the problems encountered when forming barrier ribs by a stamping process (see column 1), the patent resorts to a rolling process in which, as shown in the drawings, the glass paste is placed on a flat surface. As a roller moves across the surface of the paste, the portion of the paste in front of the roller is raised by means of the peripheral surface of the roller to form blanks. As a consequence of this procedure, an oriented formed product as in the present invention is not realized. The barrier rib blanks may be oriented in the direction that the sheet moves but they will not be oriented sufficiently in the perpendicular direction to the movement. Further, the barrier rib blanks realized do not have a reduced thickness but, quite to the contrary, have an increased thickness as can be seen in the drawings.

The process of the present invention compared to the prior art is shown in Figures 1 and 2 of this application. In Figure 1, the stacked laminate is placed in the mold and the relative size of the mold cavity and the stack are such that the area perpendicular to the pressing direction can be increased. In the TGG method of Figure 2, the stack and size of the cavity are such that no increase in area is possible. Tables 3 and 4 and the graph of Figure 3 of the application show that the orientation degree of the samples in accordance with the invention was higher than those of the samples obtained by the TGG method. As apparent from Table 3, the electromechanical coupling coefficient (%) at thickness shear mode vibration increases with an increase in the orientation degree. This result is clearly new, as evidenced by the lack of any reference disclosing this result. Nothing in the prior art teaches or suggests that the new result achieved by the present invention was possible and the fact that the claimed method achieved such results is surprising and unexpected.

None of the references, whether considered alone or in combination, suggest that pressing a sheet product formed from a ceramic slurry containing a powder of ceramic crystal grains having a shape anisotropy mixed with a ceramic raw material powder or a calcined ceramic raw material powder, or both, such that the length of the product in the direction parallel to the pressing axis is decreased and the area of the claim perpendicular to the pressing axis of the product is increased compared to those dimensions before the pressing will cause an oriented form product to be produced. The fact that such a result is achieved, as shown in the present invention, is surprising and unexpected and therefore unobvious.

In light of the foregoing considerations, it is respectfully submitted that this application is now in condition to be allowed and the early issuance of a Notice of Allowance is respectfully solicited.

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Respectfully submitted,

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